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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/879,231 | 06/11/2001 | Garo J. Derderian | MI22-1748 | 4479 |

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| EXAMINER | |
|---|---|
| LE, THAO P | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2818 | |

DATE MAILED: 04/11/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/879,231 | DERDERIAN ET AL. | |
| | Examiner | Art Unit | |
| | Thao P. Le | 2818 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *17 March 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *26 and 28-78* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *26 and 28-78* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *11 June 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *2 pages*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

***Information Disclosure Statement***

1. The information disclosure statements (IDS) submitted on 03/17/05 was filed after the mailing date of the application. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

2. Claims 26, 28-78 are pending.

3. Examiner took notice of remarks made on 03/17/05, the previous 112 and 103 rejections have been withdrawn. The traversal of 103 rejection based on the ground that Kim addresses formation of a dielectric film by ALD instead of conductive material, and no motivation exists to form metal film 52 of Fukuzumi using the dielectric film ALD method of Kim were found persuasive.

***Claim Rejections***

**Claim Rejections - 35 USC § 103**

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the

subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 26, 28-78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fukuzumi et al., U.S. Patent No. 6,222,722, and in view of Ritala et al., "Perfectly conformal TiN and Al2O3 Films Deposited by Atomic Layer Deposition", submitted by Applicant as Prior Art (IDS submitted on 03/17/05).

Regarding claims 26, 28, 31, 37-38, 43, 78, Fukuzumi et al. discloses a capacitor (See Fig. 33 and Cols. 1-20) comprising:

- a first capacitor electrode 51 over a substrate 1;
- a conductive barrier layer 52 (TiN) over the first electrode;
- a capacitor dielectric 53 over the barrier layer;
- a second capacitor electrode 54 over the dielectric layer.

Fukuzumi et al. fails to disclose a conductive barrier layer made of atomic layer deposition (ALD) technique and as a chemisorption product of first and second precursor layers. However, Ritala et al. discloses formation of a conductive barrier layer (TIN) using ALD and as a chemisorption product of a layer of first precursor made of chemisorbing method, and a second precursor of at least one monolayer thick on the first precursor layer which is made of chemisorbing method. The chemisorption product

of the first and second precursor layers being comprised by a layer of a conductive barrier material TiN.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Fukuzumi et al. in view of Ritala et al. by using ALD to deposit conductive barrier layer over the first capacitor electrode and the barrier is a chemisorption product of a first and second precursors (TiCl4, Zn, NH3 etc...) because when ALD method is performed where a high-purity film is formed by a plurality of atomic layers so that various reactants necessary for deposition of the film are sequentially supplied to the substrate by a gas pulsing method, a film having perfect step coverage is achieved, the thickness of the film can be easily adjusted, the leakage current at lower electrode is suppressed, electric potential of device acts strongly while capable of obtaining cell capacitance enough for device operation and lower a soft error rate. Ritala et al. discloses that TiN conductive layer formed by ALD method would be easily oxidized. The TiN conductive barrier layer formed over the first capacitor electrode for suppression of leakage current would react with oxygen atoms and therefore the TiN conductive layer prevent the oxygen diffusion into the lower electrode.

Regarding claims 29, 32, 34, 40, 41, 47, 48, Ritala et al. further discloses wherein the atomic layer comprises metal or metal alloys such as TiN. Still regarding to claim 34, it would have been obvious to one having ordinary skill in the art to use either

Pd or Pd alloys to form barrier layer since Pd or Pd alloys have the similar physical and chemical properties as Ir and they would yield similar result in inhibiting oxygen diffusion.

Regarding claims 30, 33, Fukuzumi et al. further discloses wherein the capacitor dielectric layer 52 is high dielectric constant material, for example, BaTiO3, SrTiO3, Ta2O5 (lines 1-25, Col. 17). It is well known in the art that these materials exhibit a K factor of greater than about 7 at 20 oC.

Regarding claims 35-36, 44, Ritala et al. further discloses wherein the first and second precursor layers each consist essentially of a monolayer, one or more chemical species and it is obvious that the precursor layers are saturated monolayers.

Regarding claims 39, 46, it would have been obvious that the atomic layer conductive barrier layer is formed on the first electrode in order to prevent the oxygen diffusion into the lower electrode.

Regarding claims 42, 49, Fukuzumi et al. discloses that at least one of the first or second electrodes comprise polysilicon (Fukuzumi et al.: Cols. 1-20) and the dielectric layer comprises oxygen (Fukuzumi et al.: lines 1-25, Col. 17).

Regarding claims 50, 57, 64, 71, Fukuzumi et al. further discloses wherein the substrate comprises a semiconductor wafer.

Regarding claim 45, Ritaka et al. discloses wherein the first and second precursors respectively comprise only one of the following pairs: TiCl4/NH3.

Regarding claims 51, 58, 65, 72, Fukuzumi discloses wherein the first capacitor electrode comprises HSG polysilicon (Fukuzumi: lines 60-61, Col. 14).

Regarding claims 52-56, 59-63, 66-70, 73-77, Fukuzumi discloses wherein the first capacitor electrode comprises HSG polysilicon (Fukuzumi: lines 60-61, Col. 14), and the atomic layer comprises TiN (line 37, Col. 8) but fails to disclose wherein the second electrode comprises the TiN. It would have been well known in the art that TiN is often used as capacitor electrode material due to its excellent conductivity. Fukuzumi further discloses wherein the dielectric layer is a high K dielectric material. It would have been obvious to one having ordinary skill in the art that Al2O3 is suitable as a high K dielectric material since Al2O3 would have similar dielectric constant as those disclosed in Fukuzumi et al.

6. When responding to the office action, Applicants' are advice to provide the examiner with the line numbers and page numbers in the application and/or references cited to assist the examiner to locate the appropriate paragraphs.

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

***Conclusion***

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao P. Le whose telephone number is 571-272-1785. The examiner can normally be reached on M-T (7-6).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on 571-272-1787. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Thao P. Le
Examiner
Art Unit 2818